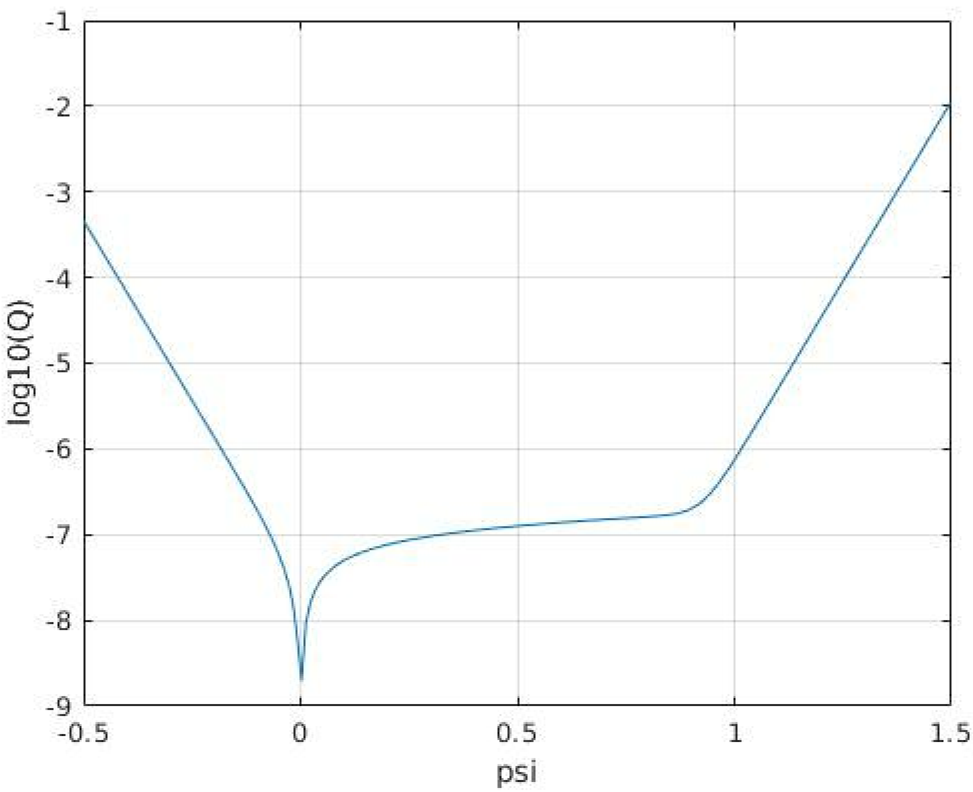
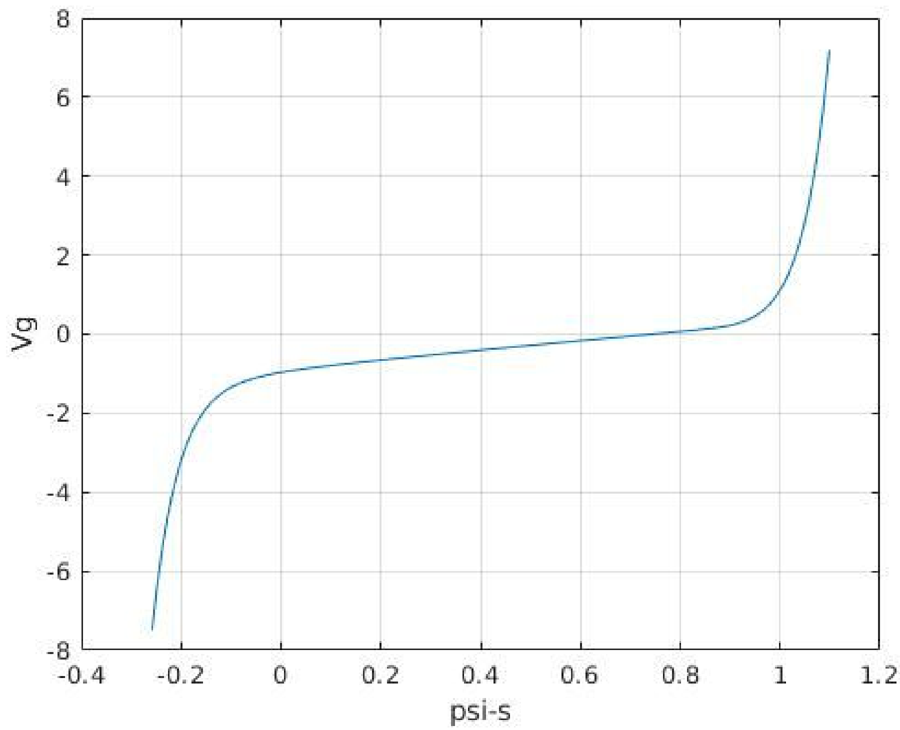
EE 620: Physics of Transistors
Assignment 1: Report

Name: Dimple Kochar
Roll No.: 16D070010

1. a1.m

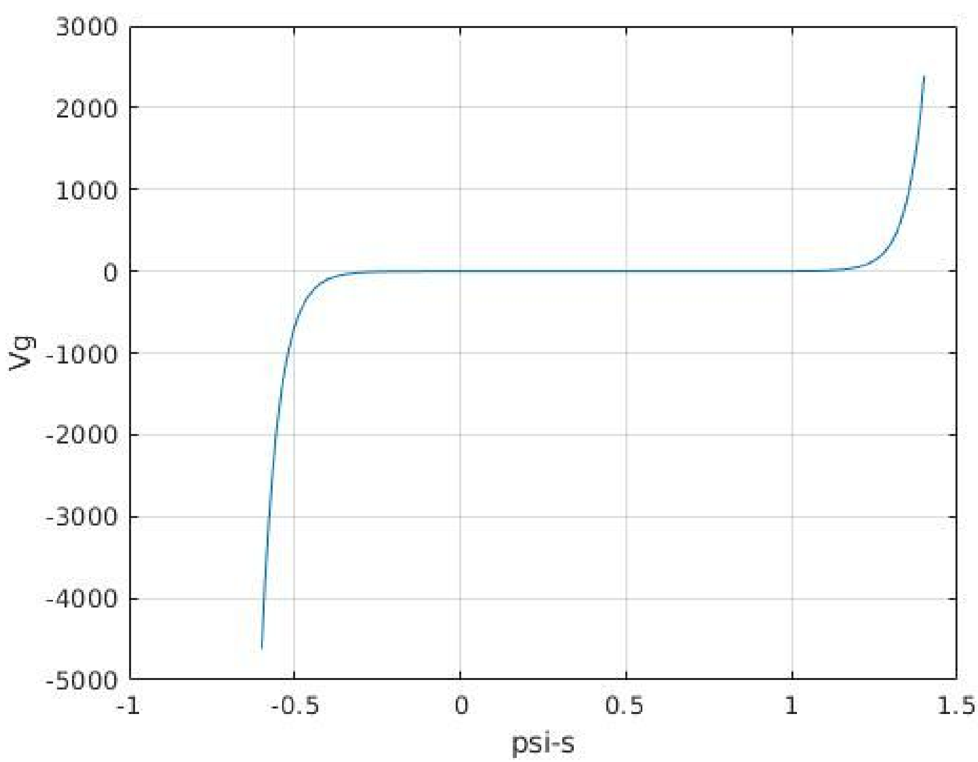


2. a2.m
Over normal ranges over Vg,



Can see that psi is 0 at Vg ~ -0.96 V which is the VFB.

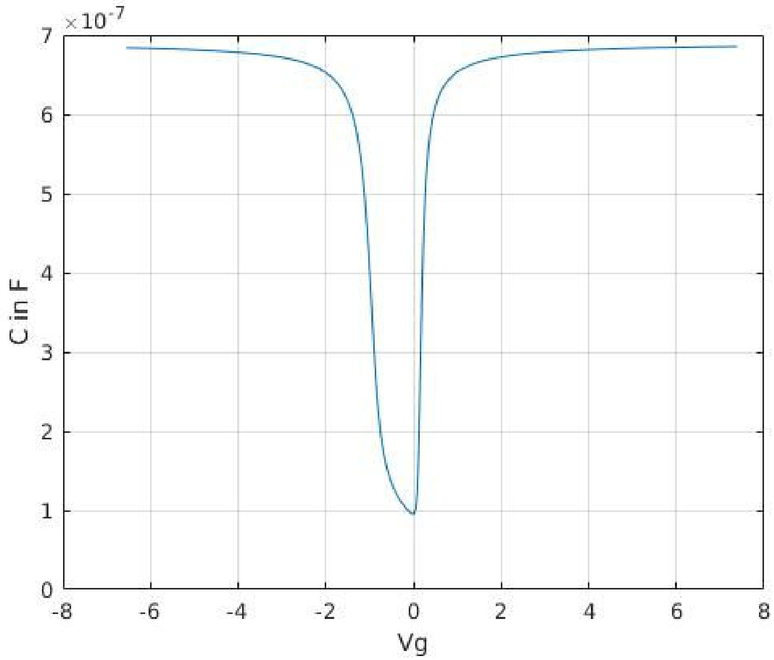
Over large ranges of Vg,



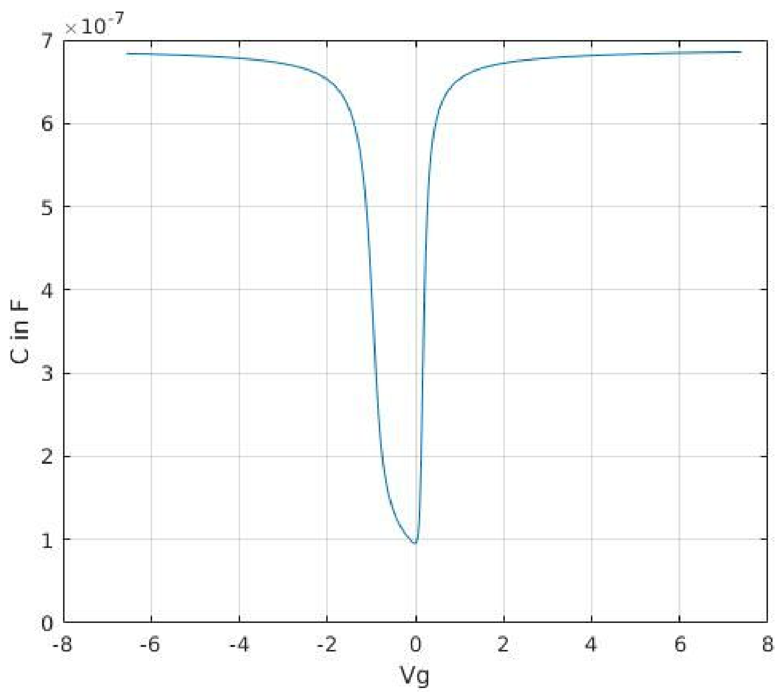
3.

a) LFCV- a3-1.m

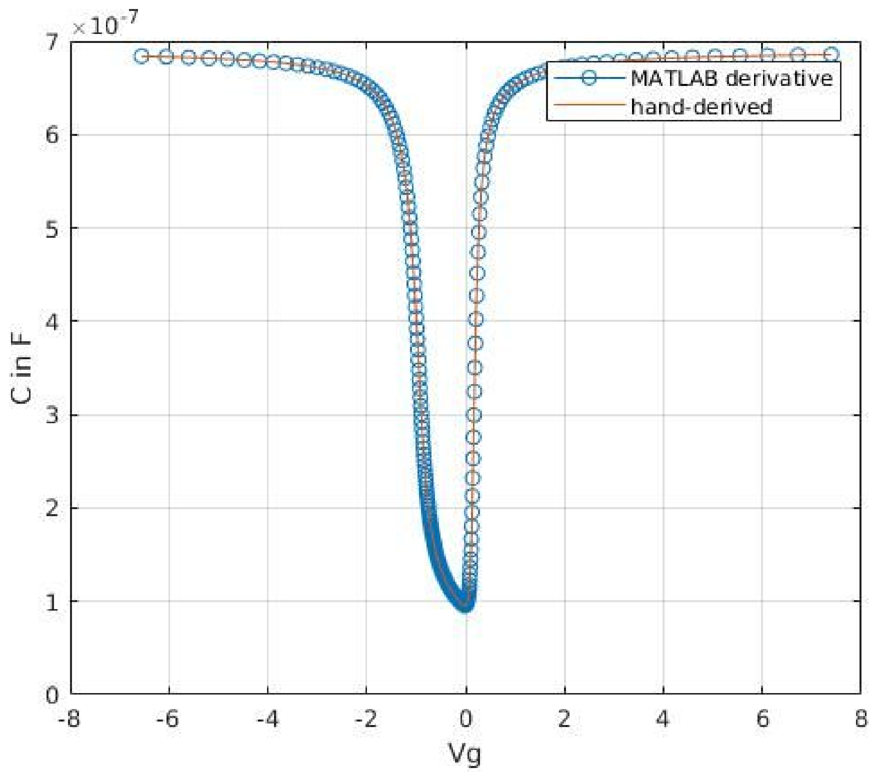
i) The numerical plot using the derivative function of MATLAB



ii) The plot made using expression calculated by taking derivative of Qs on paper



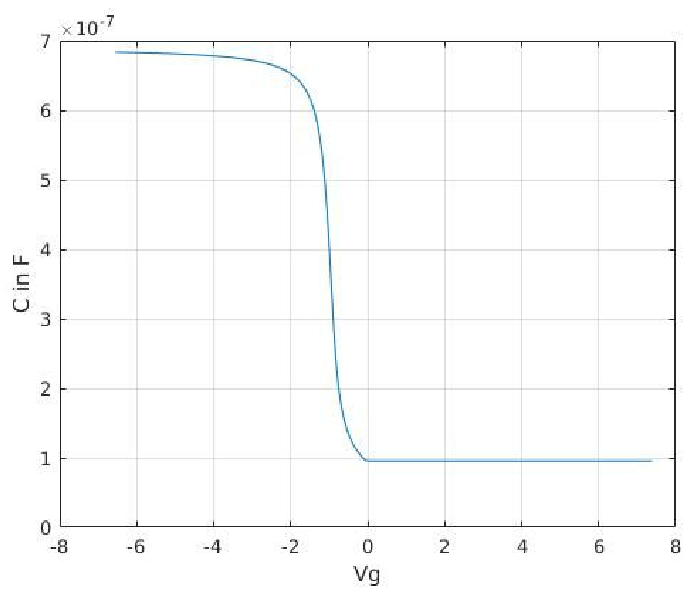
On overlapping the two, they coincide implying my calculated derivative expression is correct.



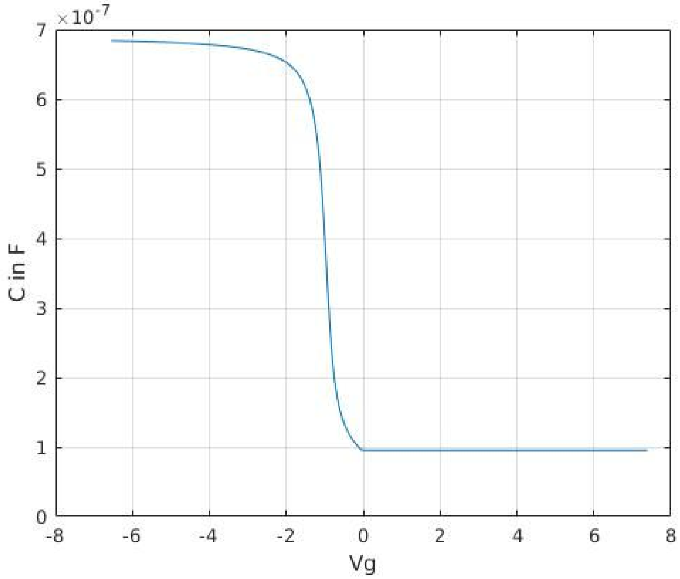
b) HFCV- a3-2.m

For HFCV, we just extend whatever minimum we get in positive Vg axis.

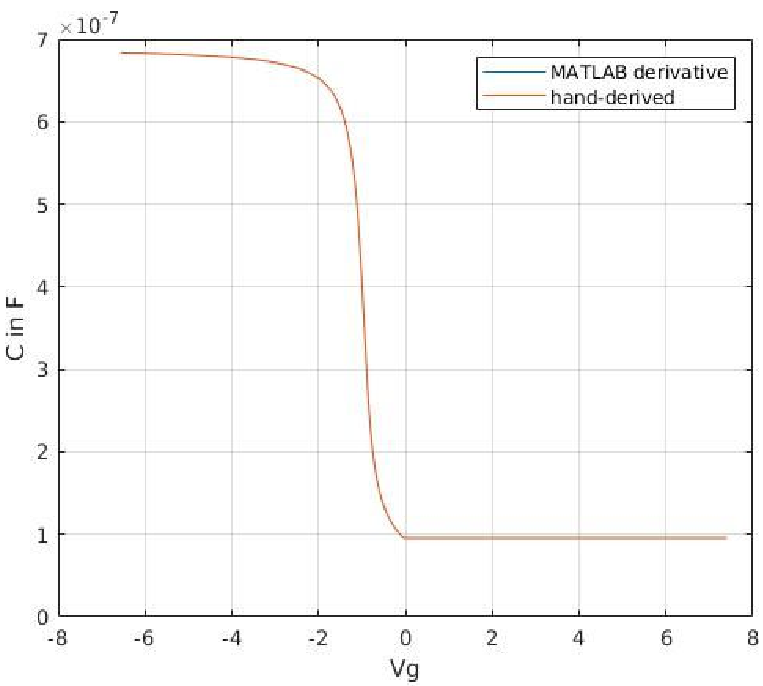
i) The numerical plot using the derivative function of MATLAB



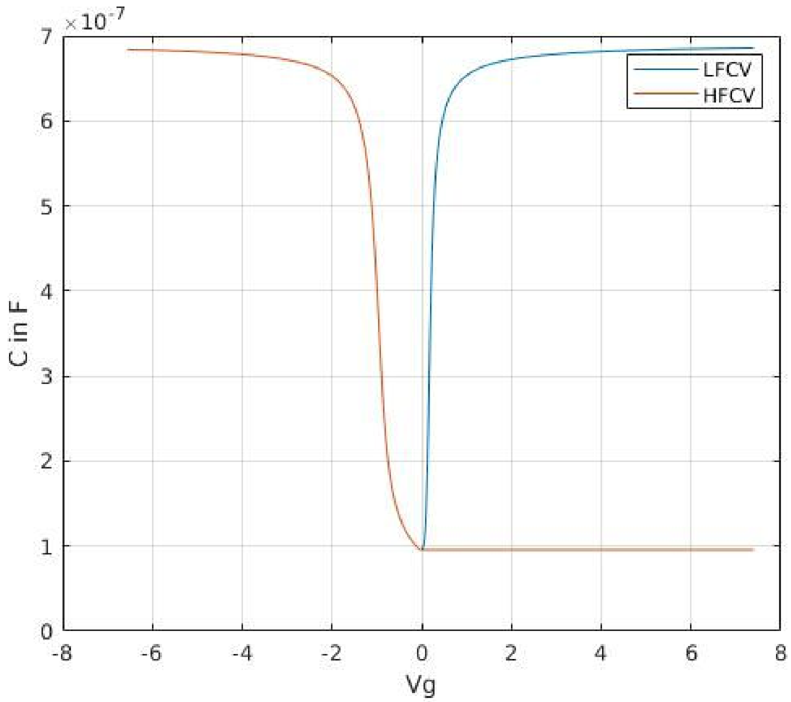
ii) The plot made using expression calculated by taking derivative of Qs on paper



On overlapping the two, they coincide implying my calculated derivative expression is correct.



HFCV and LFCV curves together:

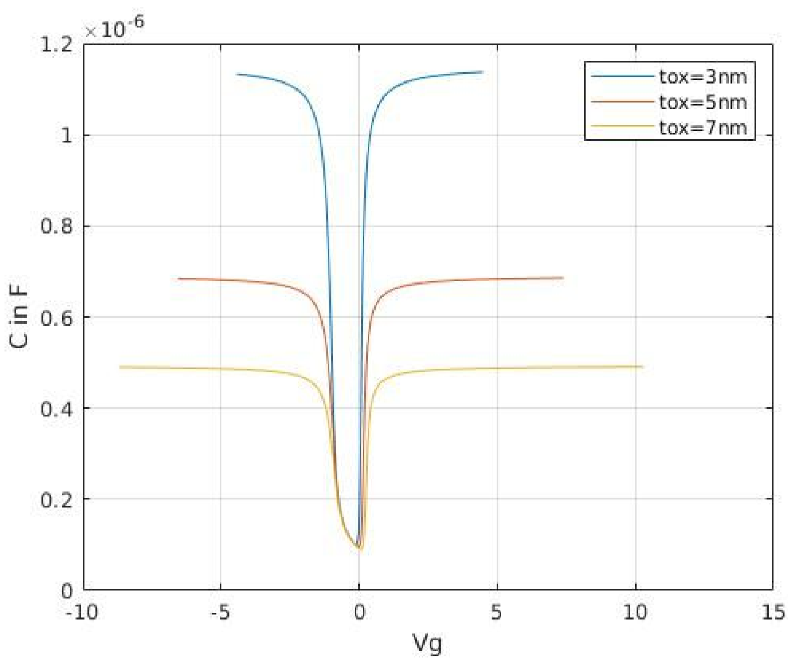


4.

Since we know our expression is correct, for this question I'll plot only my expression.

a) Varying oxide thickness: 3, 5, 7 nm for NA=10^17 cm^-3:

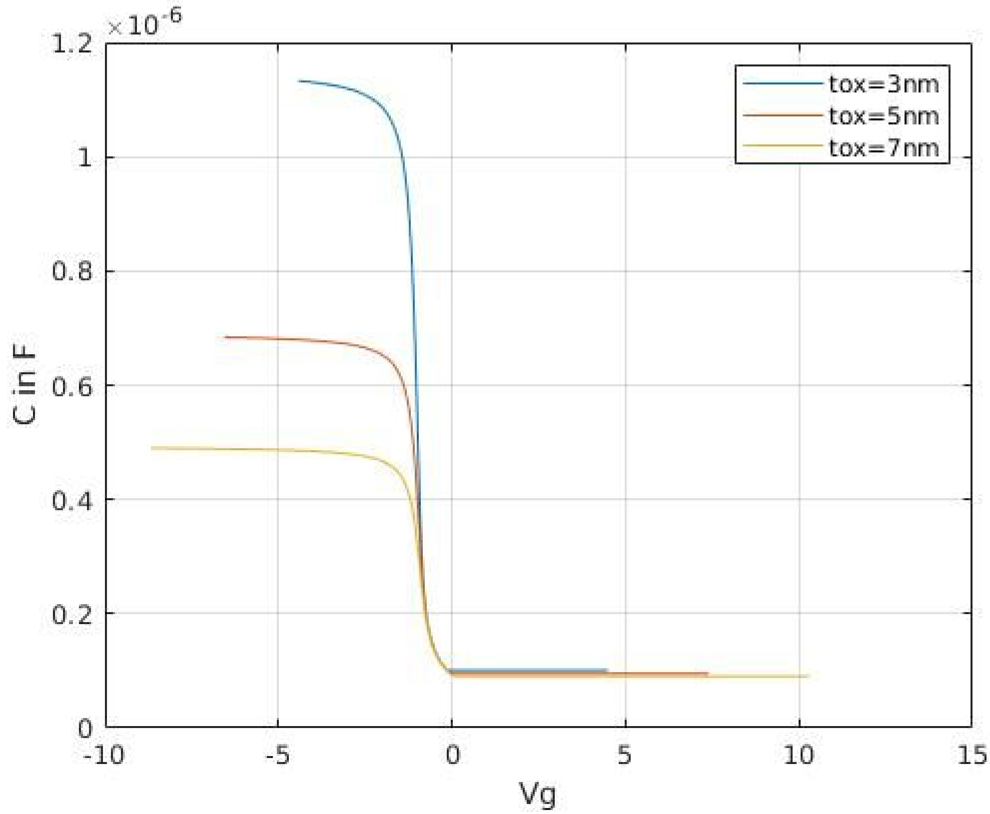
   i) LFCV: - a4_1_tox.m



LFCV in in accumulation and deep inversion has C -> Cox.

Cox is inversely proportional to Tox, That's why we get more Cox in the CV curve for lower Tox.

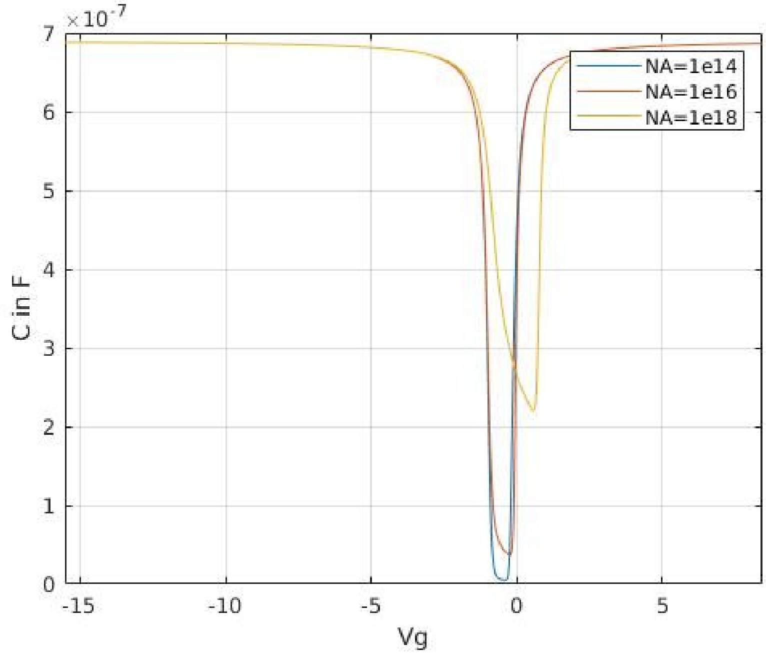
ii) HFCV: a4_2_tox.m



HFCV in in accumulation has C -> Cox.
Cox is inversely proportional to Tox, That's why we get more Cox in the CV curve for lower Tox. However, Cmin doesn't have a strong dependence on Tox. So, all HFCV curves have the same minima.

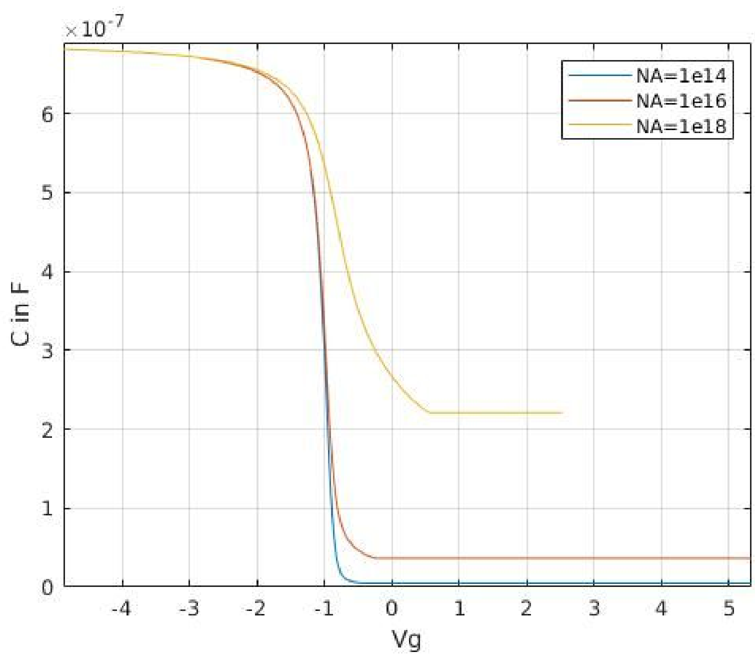
b) Varying doping concentration: 1e14, 1e16, 1e18 cm^-3 for Tox=5nm:

i) LFCV- a4_1_NA.m



On varying doping, all our parameters like VFB VMG VT change. That's why we see Cmin at different voltages. We've Cmin lower for higher dopings, because of inverse proportionality of Cs on doping concentration. Cmax however is same as Cox is the same for all three dopings, due to same Tox and same epsilon-ox.

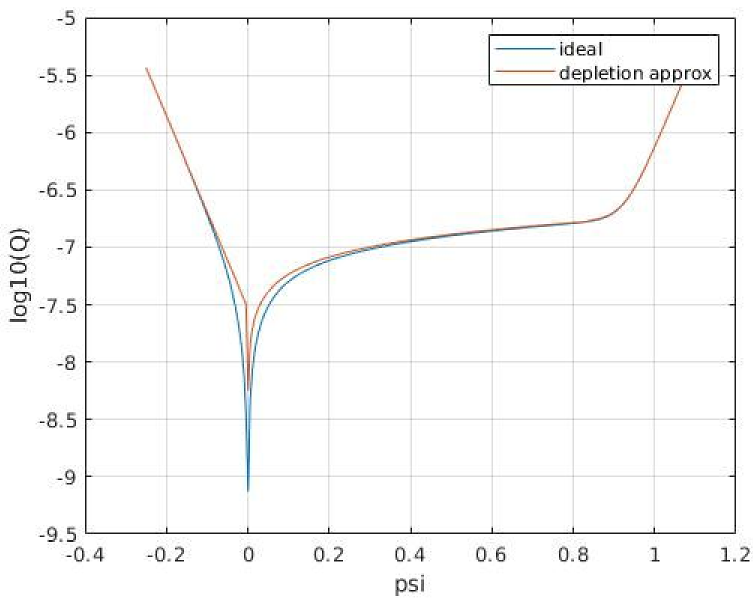
ii) HFCV- a4_2_NA.m



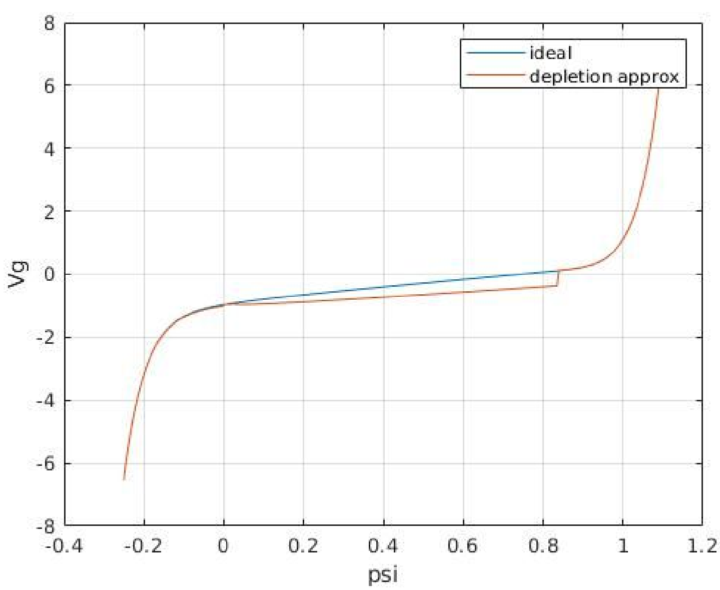
On varying doping, all our parameters like VFB VMG VT change. That's why we see Cmin at different voltages. We've Cmin lower for higher dopings, because of inverse proportionality of Cs on doping concentration. Cmax however is same as Cox is the same for all three dopings, due to same Tox and same epsilon-ox.

5) Repeating above 4 questions using depletion approximation:

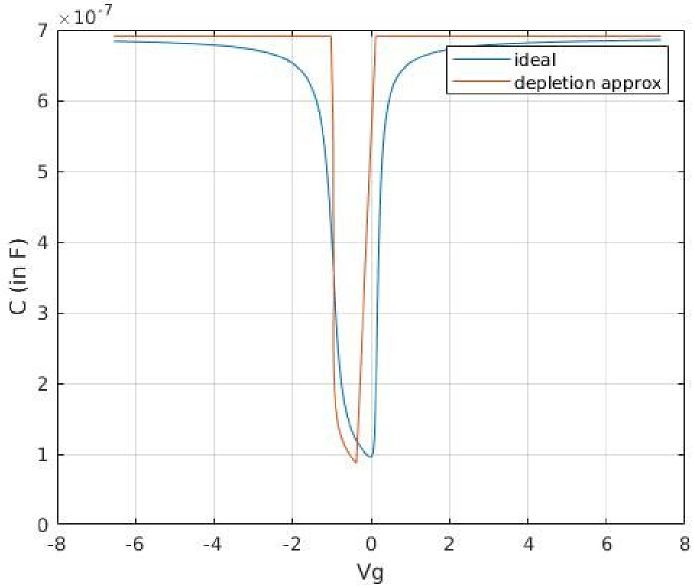
(1) a5_1.m



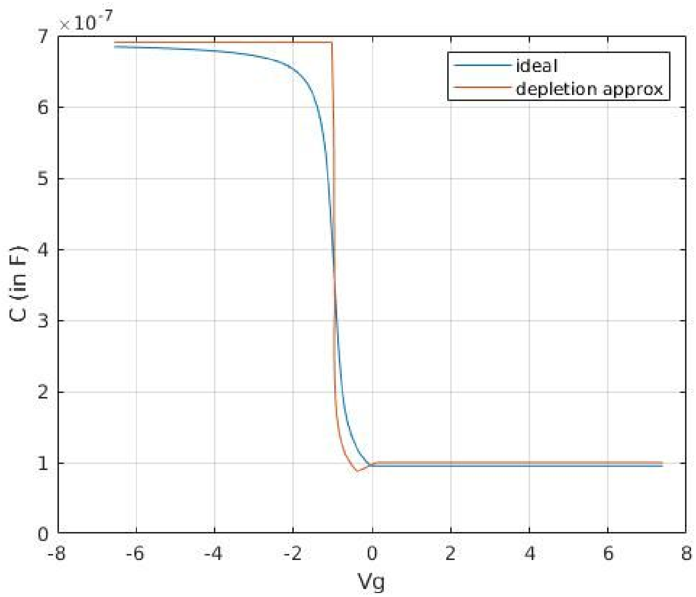
(2) a5_2.m



3) a) LFCV- a5_31.m

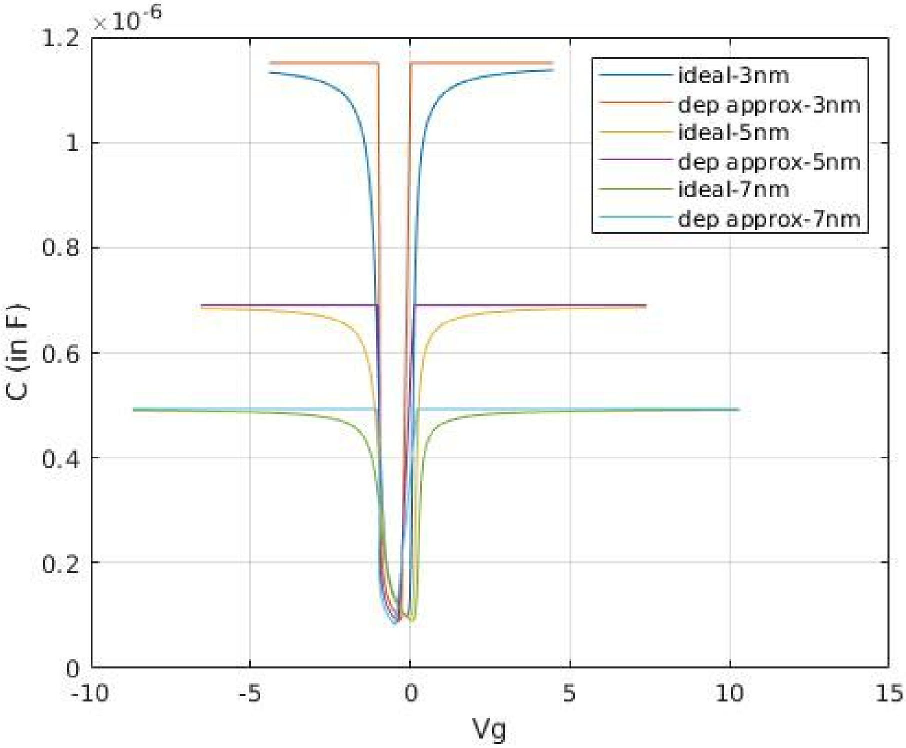


b) HFCV- a5_32.m

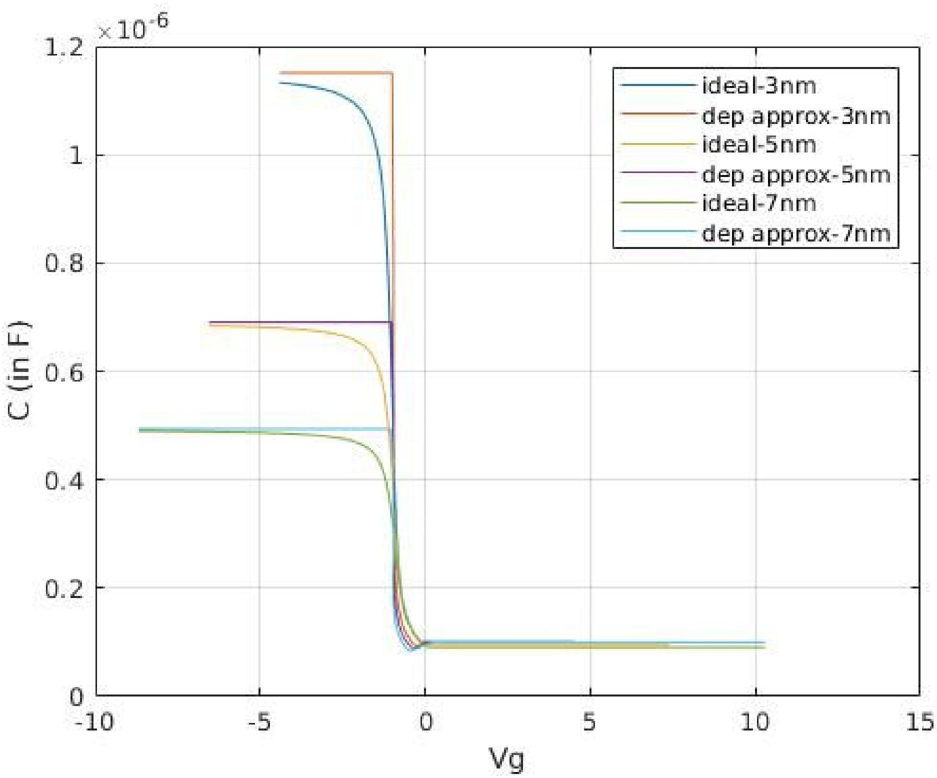


(4) (a) Varying oxide thickness

(i) LFCV- a5_41_tox.m

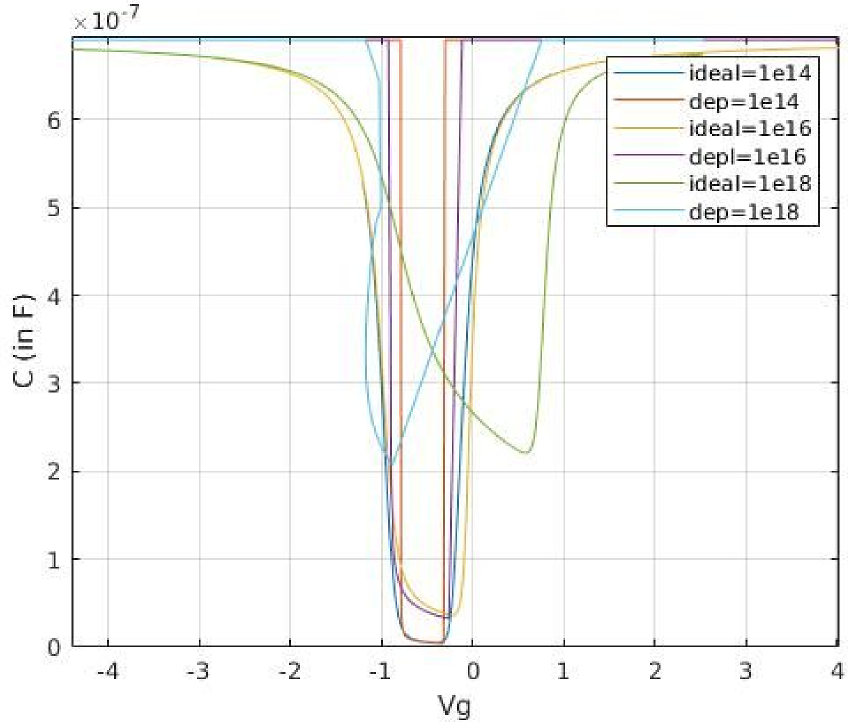


(ii) HFCV- a5_42_tox.m

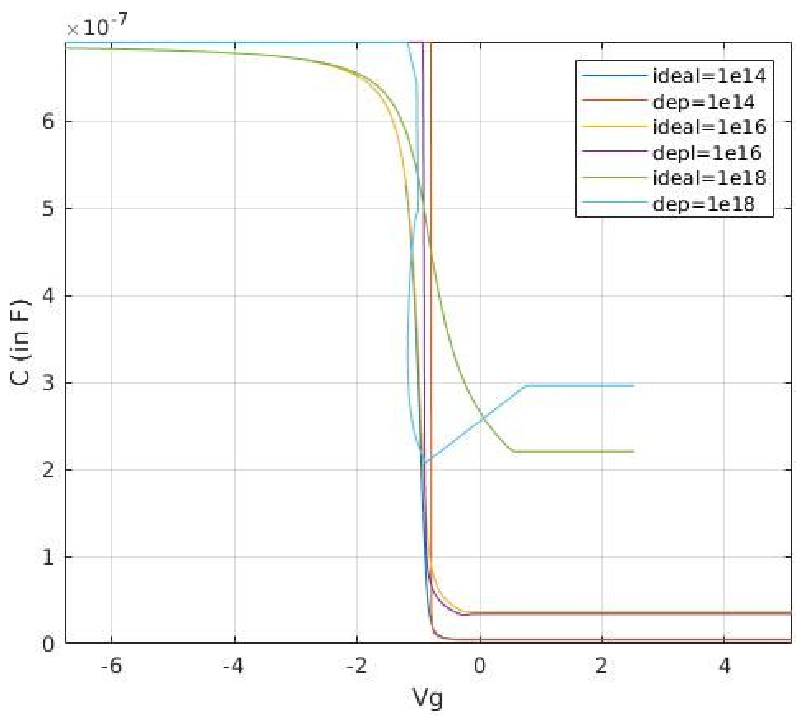


(b) Varying doping concentration

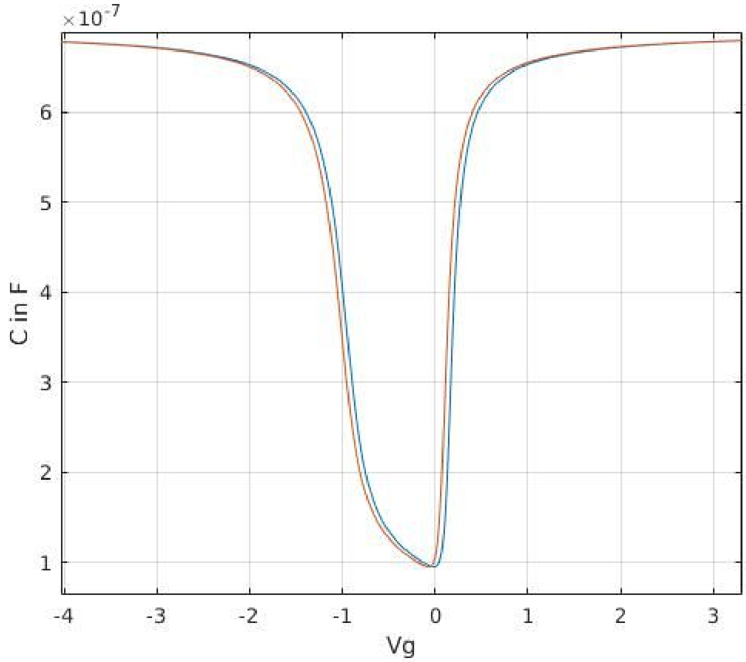
(i) LFCV- a5_41_NA.m



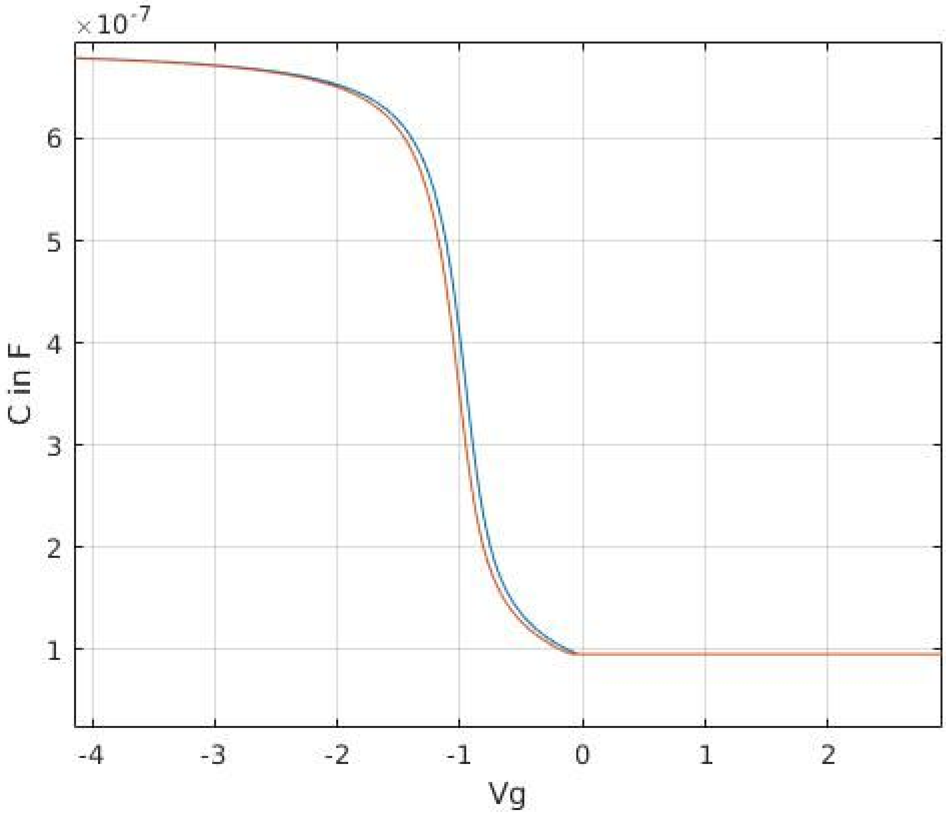
(ii) HFCV- a5_42_NA.m



6. a) LFCV- a6_1.m



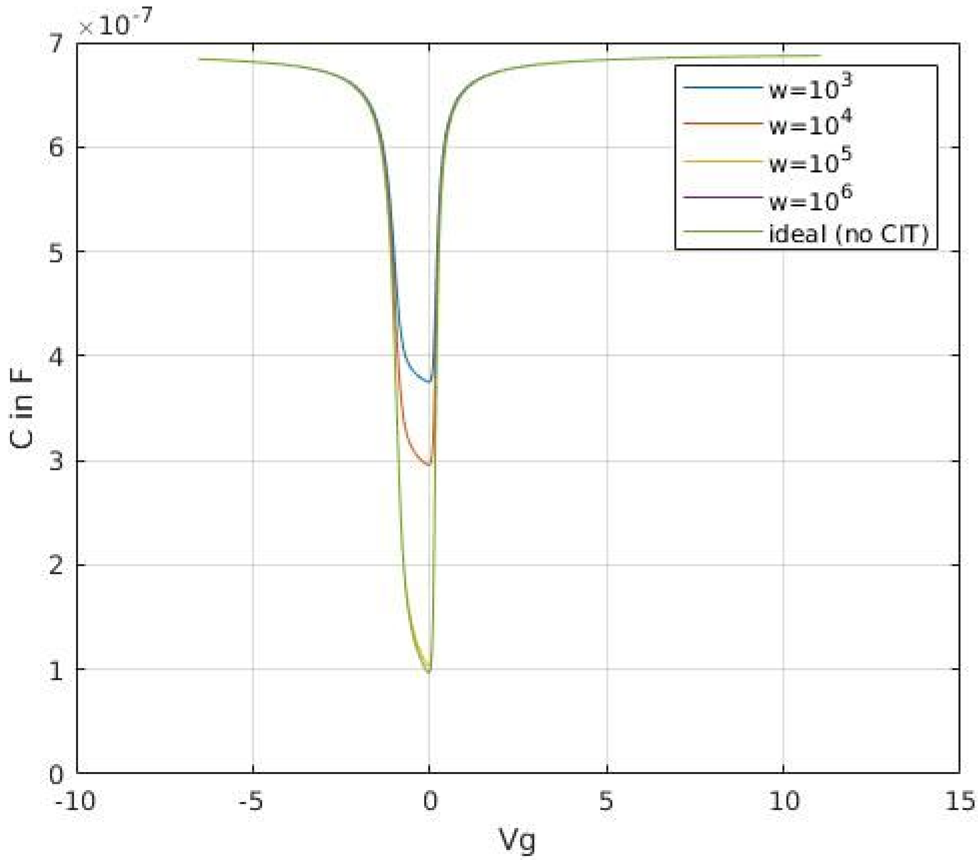
b) HFCV- a6_2.m



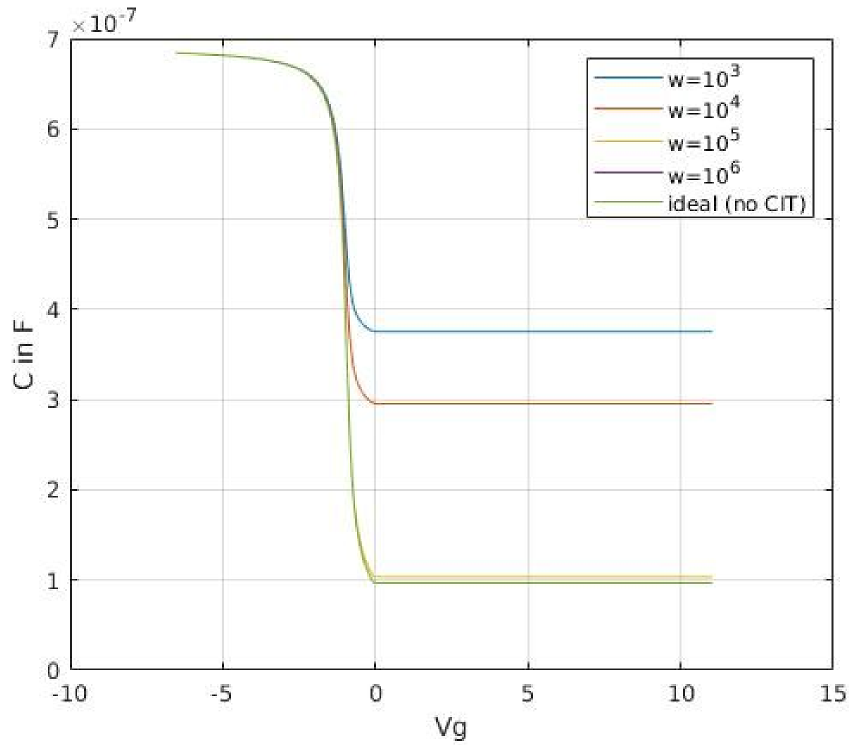
7.

I've used average dit for this. Since taking samples didn't work out (what the TA suggested on moodle and in the extra lec, do check a7.m)

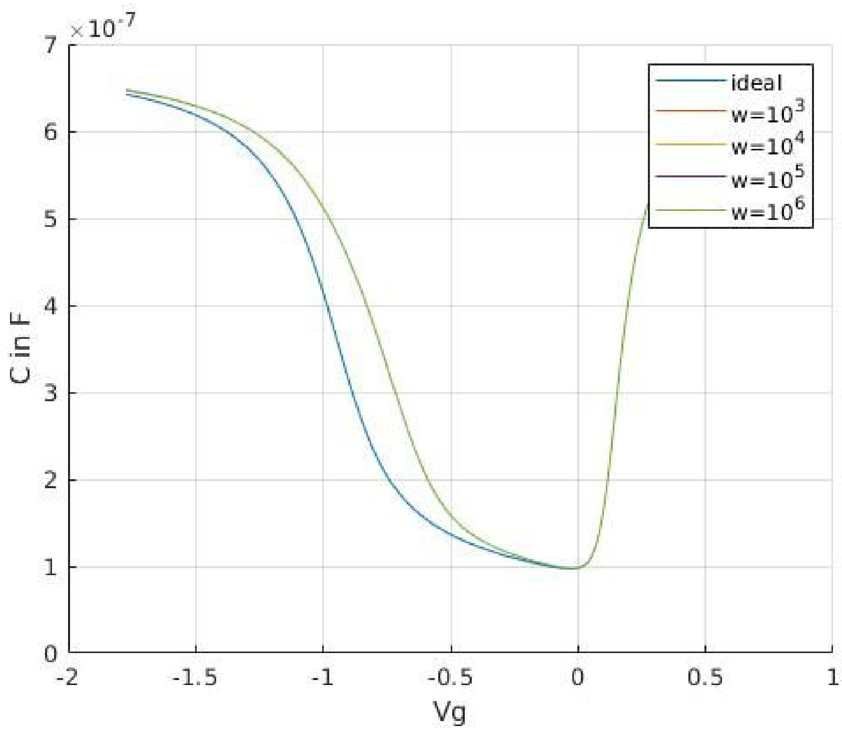
LFCV- a7_avg1.m



HFCV- a7_avg2.m



What the TA told:
LFCV- a7.m



All omegas we get same plot. Unless it’s a very large omega.